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DISCUSSION OF CONSUMPTIVE USE OF WATER BY FOREST AND RANGE VEGETATION

(Published in October, 1951)

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IRRIGATION AND DRAINAGE DIVISION

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DISCUSSION

M. J. YOUHOTSKY[11].—The data on the consumptive use of water by forest and range vegetation, as presented by Mr. Rich, were obtained by observing transplanted plants, and from the untreated Base Rock lysimeter. The task of obtaining direct evapo-transpiration data for some stands of timber, in their natural condition, and correlating such data to the volume of vegetation in the plant community, appears to be interesting but difficult. Under certain

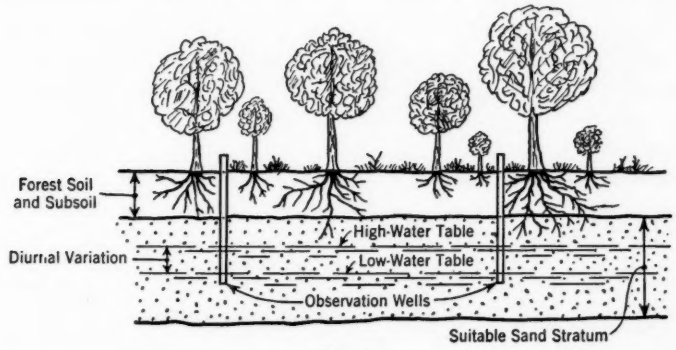

FIG. 4

conditions, when the stand is fed by a shallow ground-water level, the proposed method of observing the fluctuations of the water-table elevations may prove useful.

In connection with a proposed hydrological survey of the Red Gum (Eucalyptus Rostrata) forests,[12] in Australia, the writer has suggested that this method be given a trial. These forests grow on flat alluvial land in the central part of the basin of the Murray River and thrive in the nearly arid climate of southeastern Australia with 15 in. of annual rainfall. Conditions most favorable for this type of observation are demonstrated diagrammatically in Fig. 4. The forest soil is shown overlying a stratum of uniformly-grain alluvial sand for which the porosity coefficient is easily obtainable. Tubular wells with accurate hook gages are arranged within each test plot as shown in Fig. 5. The diurnal variation of the water table, multiplied by the area of the test plot and by the porosity coefficient, will give the evapo-transpiration use of water by the given plant community during a given day.

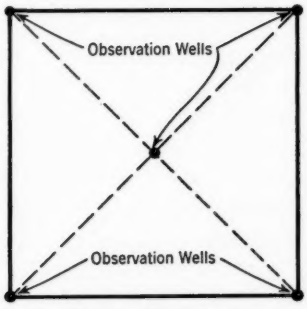

FIG. 5.—TEST PLOT

NOTE.—This paper by L. R. Rich was published in October, 1951, as *Proceedings-Separate No. 90*. The numbering of footnotes and illustrations in this Separate is a continuation of the consecutive numbering used in the original paper.

[11] Box 2967, G. P. O., Sydney, New South Wales, Australia.

[12] *New South Wales Forestry Recorder*, No. 1, 1948.

Consider a fairly extensive forest, situated at a low elevation, with flat terrain. If the gradation of the underlying sand is sufficiently small, any inflow of water from outside the bounds of the test plot may be disregarded, because the fluctuations of the water table are a function of evapo-transpiration.

Correction may be needed for the possible tidal effect of the moon. If so this phase could be investigated on a sufficiently large, cleared, land area of the same type and geology as the test plot.

L. R. RICH[13].—As stated by Mr. Youhotsky, the task of obtaining direct evapo-transpiration data for stands of timber in their natural condition and correlating such data to the volume of vegetation in the plant community is both interesting and difficult. The method suggested—diurnal fluctations of the water table where the vegetation is fed by a shallow ground-water table—should prove satisfactory under certain conditions. Previous work by G. E. P. Smith, M. ASCE, and Walter N. White[14] has shown that diurnal fluctuations of the water table can result from growing vegetation, drawing its supply from a shallow water table. Mr. White suggested a method for computing consumptive use of water by the vegetation. C. H. Lee, M. ASCE, discussed this method as follows[15]:

> "The method has application in areas of shallow water table where vegetation depends entirely on ground water. * * * Its greatest value is in areas where inflow and outflow are at scattered or inaccessible points and not susceptible of accurate measurements."

The experiment Mr. Youhotsky suggests should add worth-while data to the subject of consumptive use of water by forest vegetation under natural conditions. However, the evapo-transpiration rates from this type of experiment would probably be much higher than those from the forests at Sierra Ancha Experimental Forest, and higher than most of the forest areas in the arid West, because most of these areas do not have an unlimited water supply such as a shallow water table.

Forests grow under different conditions. Some areas have an unlimited water supply. In these areas consumptive use depends on growing conditions and would probably exceed average percipitation over much of the West. Other areas, which make up most of the forest and range lands of the West, do not have an unlimited water supply. The writer illustrated this point in Fig. 1, in which it was demonstrated that during 1940–1941, when percipitation was almost double the average, consumptive use in the forested watershed of Workman Creek exceeded the average annual precipitation; yet, during years that approached average conditions as well as years of below average precipitation, the trees made some growth, and stream flow, although below that of 1940–1941, was maintained. In this area most of the forest grows on well-

[13] Hydrologist, Southwestern Forest and Range Experiment Station, Tuscon, Ariz.

[14] "A Method of Estimating Ground-Water Supplies Based on Discharge by Plants and Evaporation from Soil, Results of Investigations in Escalante Valley, Utah," by Walter N. White, *Water-Supply Paper No. 659-A*, 1932, Geological Survey, U. S. Dept. of the Interior, Washington, D. C.

[15] "Hydrology," *Physics of the Earth Series*, Vol. IX, ed. by Oscar E. Meinzer, McGraw-Hill Book Co., Inc., New York, N. Y., 1942, pp. 259–330.

drained slopes; an unlimited water supply is confined to a period in the winter and spring when use is limited by growing conditions. This period is followed by a water-deficit period during late spring, summer, and early fall months when water use would be highest if there were an unlimited supply. Consequently, consumptive use by forest trees on these well drained slopes depends on water available rather than on the capability of the forest vegetation to use water.

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